

Claims

1. A photopolymer mixture comprising at least a first polymerisable material and a second polymerisable material in proportion such that the mixture has a predetermined surface energy when cured.
2. A photopolymer mixture as claimed in claim 1 wherein the surface energy is such that, in use in a liquid crystal cell, the photopolymer imparts a predetermined orientation of the liquid crystal director with respect to the local surface normal.
3. A photopolymer mixture as claimed in claim 2 wherein the predetermined orientation is a homeotropic orientation.
4. A photopolymer mixture as claimed in any preceding claim wherein the first short chain polymerisable material is an oligomer or diluent.
5. A photopolymer mixture as claimed in any preceding claims wherein the second short chain polymerisable material is a monomer.
6. A photopolymer mixture as claimed in any preceding claim wherein the mixture further comprises an additive.
7. A photopolymer mixture as claimed in claim 6 wherein the additive reduces the surface energy of the cured mixture.
8. A photopolymer mixture as claimed in claim 7 wherein the additive is an acrylate or an epoxy functionalised polydimethyl siloxane material.
9. A photopolymer mixture as claimed in any preceding claim wherein the surface energy is less than  $4 \times 10^{-2}$  N/m.
10. A photopolymer mixture as claimed in any preceding claim wherein the surface energy of the cured photopolymer has a dispersive energy of between 12 mN/m and 40 mN/m and a polar energy of between 0.0mN/m and 15mN/m.

11. A photopolymer mixture as claimed in any preceding claim wherein the mixture comprises an immiscible component.
12. A photopolymer mixture as claimed in claim 11 wherein the immiscible component comprises one of the polymerisable materials.
13. A photopolymer mixture as claimed in claim 11 wherein the immiscible component comprises a solid particulate.
14. A photopolymer mixture as claimed in any preceding claim wherein the proportion of first material to second material is such so as to give a predetermined viscosity and refractive index.
15. A photopolymer mixture as claimed in claim 12 wherein the refractive index is between 1.35 and 1.80.
16. A photopolymer mixture as claimed in claim 12 or claim 13 wherein the viscosity of the uncured photopolymer is between 5 centipoise and 10 poise.
17. A photopolymer mixture comprising a first component and a second component together being capable of cured to form a polymeric material having a predetermined surface energy.
18. A photopolymer mixture according to claim 17 having a cured surface energy of less than  $4 \times 10^{-2} \text{N/m}$  or less than  $3.5 \times 10^{-2} \text{N/m}$  or less than  $2.5 \times 10^{-2} \text{N/m}$ .
19. A liquid crystal alignment layer comprising a polymerised photopolymer bearing a surface profile characterised in that the polymerised photopolymer comprises a photopolymer mixture as claimed in any previous claim which has been cured.
20. A liquid crystal alignment layer according to claim 19 wherein the alignment layer is formed on a substrate and surface energy of the alignment layer in contact with the substrate is greater than the surface energy of the alignment layer which, in use, contacts the liquid crystal material.

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21. A liquid crystal alignment layer according to claim 19 or claim 20 wherein the alignment layer imparts a substantially homeotropic orientation to liquid crystal material.
22. A liquid crystal cell comprising a liquid crystal material located between two cell walls wherein at least one of the cells walls carries an alignment layer according to any of claims 19 to 21.
23. A liquid crystal cell as claimed in claim 22 wherein the alignment layer has the same apparent refractive index as the liquid crystal material.
24. A method of making an alignment layer for a liquid crystal material comprising the steps of;
  - i) taking a photopolymer mixture,
  - ii) introducing the photopolymer mixture to a substrate,
  - iii) taking a master bearing an inverse of the desired grating and impressing it into the photopolymer mixture on the substrate,
  - iv) curing the photopolymer mixture on the substrate, and
  - v) removing the master from the cured photopolymer mixturecharacterised in that the photopolymer mixture comprises the photopolymer mixture according to any of claims 1 - 18.
25. A method of making an alignment layer as claimed in claim 24 wherein the photopolymer mixture has a component which has a lower surface energy than the rest of the mixture and the step of curing the photopolymer mixture involves curing the mixture such that there is a greater concentration of the lower surface energy component at one surface of the cured mixture than the other.
26. A photopolymer mixture comprising a first polymerisable material and a second polymerisable material, the proportion of first polymerisable material to second polymerisable material being such that the photopolymer mixture has a predetermined viscosity and refractive index.